WHAT IS CLAIMED IS:

1. A method of performing a lateral epitaxial overgrowth of a planar, non-polar, a-plane gallium nitride (GaN) film, comprising:

(a) patterning a mask deposited on a substrate; and

(b) performing a lateral epitaxial overgrowth of the GaN film off the substrate using hydride vapor phase epitaxy, wherein the GaN film nucleates only on portions of the substrate not covered by the patterned mask, the GaN film grows vertically through openings in the patterned mask, and the GaN film then spreads laterally above the patterned mask and across the substrate's surface.

2. The method of claim 1, wherein the lateral epitaxial overgrowth utilizes growth pressures of approximately atmospheric pressure (760 Torr) or below, and a carrier gas containing a fraction of hydrogen.

3. The method of claim 1, wherein the growth pressure is less than 300 Torr.

4. The method of claim 1, wherein the growth pressure ranges from 5 to 100 Torr.

5. The method of claim 1, wherein the carrier gas is predominantly hydrogen.

6. The method of claim 1, wherein the carrier gas comprises a mixture of hydrogen and nitrogen, argon, or helium.

7. The method of claim 1, wherein the lateral epitaxial overgrowth reduces threading dislocation densities in the GaN film.

8. The method of claim 1, wherein the substrate comprises sapphire.

9. The method of claim 1, wherein the patterned mask is comprised of a metallic material.

10. The method of claim 1, wherein the patterned mask is comprised of a dielectric material.

11. The method of claim 1, wherein the patterned mask is a silicon dioxide (SiO_2) mask containing apertures or stripes allowing access to the substrate underlying the mask.

12. The method of claim 1, wherein the patterning step comprises:

depositing a silicon dioxide (SiO_2) film on the substrate;

patterning a photoresist layer on the silicon dioxide film;

etching away any portions of the silicon dioxide film exposed by the patterned photoresist layer;

removing remaining portions of the photoresist layer; and

cleaning the substrate.

13. The method of claim 1, wherein the substrate is coated with a template layer of GaN, aluminum nitride (AlN), aluminum gallium nitride (AlGaN), or other thin film.

14. The method of claim 1, wherein the substrate is a free-standing *a*-plane GaN, *a*-plane aluminum nitride (AlN), or *a*-plane aluminum gallium nitride (AlGaN) wafer.

15. The method of claim 1, wherein the substrate is coated with a nucleation layer deposited at either low temperatures or at the growth temperature.

16. A free-standing *a*-plane GaN film or substrate manufactured using the method of claim 1.

17. A device manufactured using the method of claim 1.

18. The device of claim 17, wherein the device is a laser diode, light-emitting diode or transistor.

19. A lateral epitaxial overgrowth of a planar, non-polar, a-plane gallium nitride (GaN) film off a substrate, wherein the lateral epitaxial overgrowth is created using a process comprising:

(a) patterning a dielectric mask deposited on a substrate; and

(b) performing a lateral epitaxial overgrowth of the GaN film off the substrate using hydride vapor phase epitaxy, wherein the GaN film nucleates only on portions of the substrate exposed by the patterned dielectric mask, the GaN film grows vertically through openings in the patterned dielectric mask, and the GaN film then spreads laterally above the patterned dielectric mask and across the substrate's surface.